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Freshwater Mussels of the Rock River

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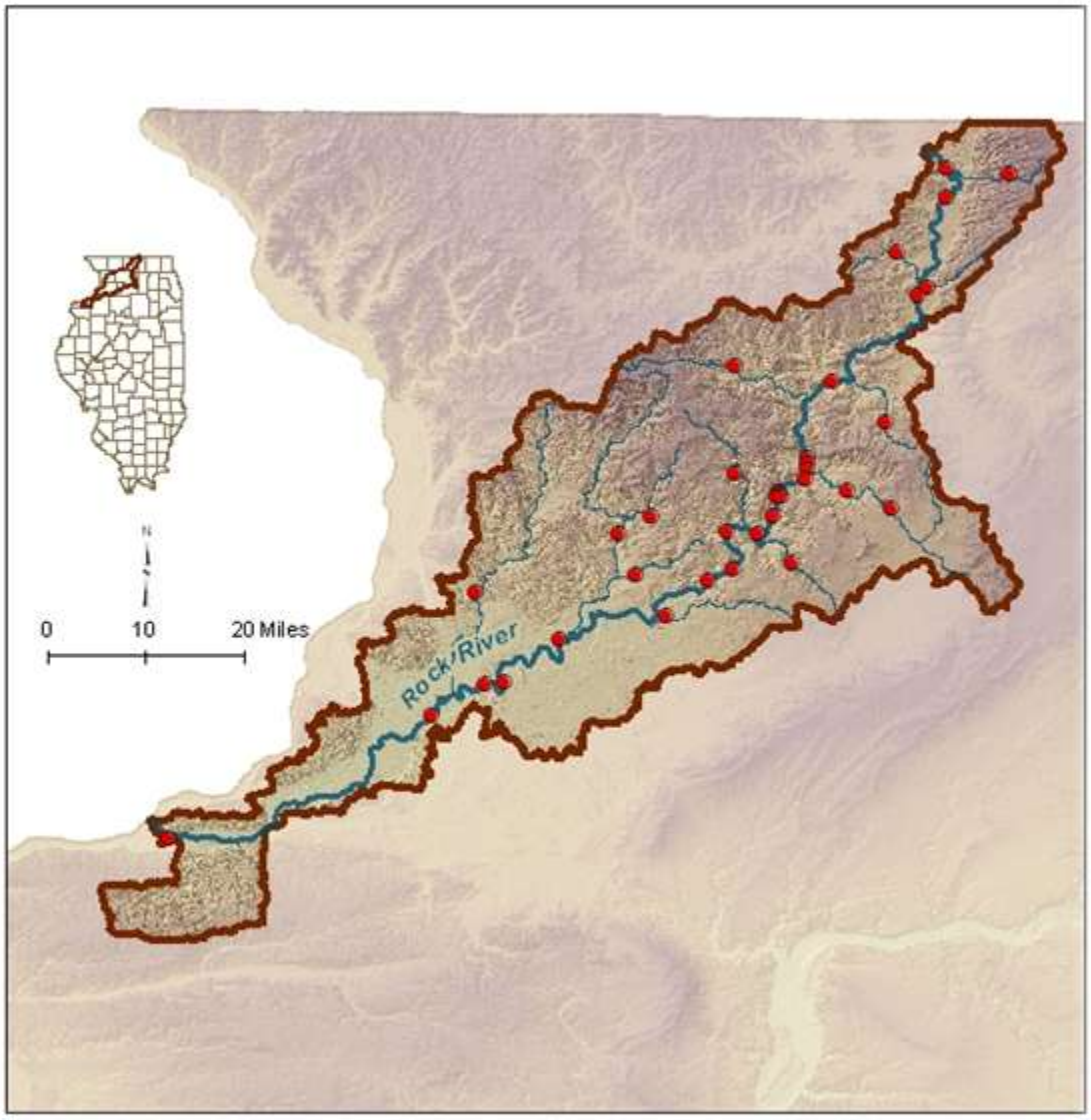

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Preface

While broad geographic information is available on the distribution and abundance of mussels in Illinois, systematically collected mussel-community data sets required to integrate mussels into aquatic community assessments do not exist. In 2009, a project funded by a US Fish and Wildlife Service State Wildlife Grant was undertaken to survey and assess the freshwater mussel populations at wadeable sites from 33 stream basins in conjunction with the Illinois Department of Natural Resources (IDNR)/Illinois Environmental Protection Agency (IEPA) basin surveys. Inclusion of mussels into these basin surveys contributes to the comprehensive basin monitoring programs that include water and sediment chemistry, instream habitat, macroinvertebrate, and fish, which reflect a broad spectrum of abiotic and biotic stream resources. These mussel surveys will provide reliable and repeatable techniques for assessing the freshwater mussel community in sampled streams. These surveys also provide data for future monitoring of freshwater mussel populations on a local, regional, and watershed basis.

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Introduction

Freshwater mussel populations have been declining for decades and are among the most seriously impacted aquatic animals worldwide (Bogan 1993, Williams et al. 1993). It is estimated that nearly 70% of the approximately 300 North American mussel taxa are either federally-listed as endangered or threatened, extinct, or in need of conservation status (Williams et al. 1993, Strayer et al. 2004). In Illinois, 25 of the 62 extant species (44%) are listed as threatened or endangered (Illinois Endangered Species Protection Board 2011). While broad geographic information is available on the distribution and abundance of mussels in Illinois, systematically collected mussel-community data sets required to integrate mussels into aquatic community assessments do not exist. Baker (1926) conducted the first comprehensive review of mussel fauna in the Rock basin; however, since then, only sporadic sampling has occurred. This report summarizes the mussel survey conducted in conjunction with IDNR and IEPA basin survey sites in the Rock River mainstem and its minor tributaries in 2009.

The Rock River originates in Wisconsin at Horicon Marsh, Dodge County, flows southward into Winnebago County, Illinois then shifts southwesterly through Ogle, Lee, Whiteside, Henry, and Rock Island counties (Sinclair 1996, Figure 1). The mainstem of the river flows for 163 miles in Illinois, encompassing a total of 318 miles from Wisconsin to its mouth on the Mississippi River (Sinclair 1996). The Rock River drains approximately 27,270 km^2 (10,915 mi^2), with an approximate drainage of 9,200 km^2 (3,550 mi^2) in Illinois (Luman 2002). Three major tributaries, the Green, Pecatonica, and Kishwaukee Rivers, drain into the Rock River. This report focuses on the Rock River mainstem and direct minor tributaries whereas the three major tributaries will be covered in the Rock River tributaries report.

Major portions of the Rock mainstem plus its minor tributaries flow through the geographic division of the Rock River Hill Country (Knapp 1998). Other natural divisions within the basin include the Northeastern Morainal, Grand Prairie, Middle Mississippi Border, and Upper Mississippi River and Illinois River Bottomlands (Schwegman 1973). Rolling hills and surficial bedrock, creating scenic rocky bluffs and ravines, characterize the Rock River Hill Country physiography (IDNR 2001). Baker (1926), qualifying this area of the state, wrote "the Rock River system is admirably adapted for ecological study on account of its diversity of form, embracing every variation of vital character—large and small lakes, swamps, creeks, small, medium and large size rivers. For comparison of fauna with physiography it is unsurpassed."

Land use and Instream Habitat

Historically, expansive wetlands along with prairies (1/3 of the landscape) and forests covered the basin (IDNR 2001). Many of the wetlands have been drained, tiled, and converted to cropland that today accounts for 61% of land use in the basin (IDNR 2001, Page et al. 1992).

Grasslands, including pastures and some prairie, now account for approximately 23% of land use (IDNR 2001).

Two major urban areas in the Rock River basin are Rockford and Rock Island/Moline with populations of about 154,000 and 60,250, respectively (US Census Bureau 2010). Seven dams exist on the Rock River and are located at Rock Island/Moline, Sterling/Rock Falls, Dixon, Oregon, Rockford, and Rockton. These dams alter flow regime, river depth, and create sluggish pools throughout the river system (Page et al. 1992). The Rock River has acquired residential and industrial pollution from municipal and industrial development (Miller 1972, Page et al. 1992). The Rock River is considered 'fully supporting' of aquatic life and fish consumption based on IEPA standards, although primary and secondary contact levels were not assessed (IEPA 2010). However, much of the mainstem contains mercury and polychlorinated biphenyls from toxic deposition; in addition, fecal coliform is present around municipal areas like Rockford and Rock Island/Moline, largely due to urban runoff and storm sewer discharge (IEPA 2010).

In late summer, the Rock River typically becomes shallow and wadeable in various areas throughout the river and islands often appear mid-stream (Figure 2). Substrates in the main channel of the Rock River vary from predominately cobble, consolidated gravel and sand, to sand and silt in slack water areas near islands or banks. Exposed bedrock is uncommon but outcrops along banks occasionally. A forested riparian zone is common along the majority of the Rock River. The minor tributaries of the Rock River naturally meander and consist largely of consolidated gravel and sand substrate in runs (Figure 3) to cobble riffles and sandy pools. Claypan or silt is commonly found along banks. One site was predominately cobble and gravel (site 30, Franklin Creek) and one site (site 36, Rock Creek) was mostly unconsolidated sand and claypan. These minor tributary sites are normally wadeable with average depths of less than a meter throughout the summer and fall months.

Methods

During the 2009 survey, freshwater mussel data were collected at 36 sites: 22 mainstem and 14 tributary sites in the Rock River basin (Figure 1; Table 1). Locations of sampling sites are listed in Table 1 along with IDNR/IEPA sampling type information. In most cases, mussel survey locations were the same as IDNR/IEPA sites. Due to a fish kill that occurred on the Rock River in July 2009, a more intensive sampling effort was conducted on the river with the help of IDNR and the U. S. Fish and Wildlife Service biologists. These sites are identified by "MU" under sampling type in Table 1.

Live mussels and shells were collected at each sample site to assess past and current freshwater mussel occurrences. Live mussels were surveyed by hand grabbing and visual detection (e.g.,

trails, siphons, exposed shell) when water conditions permitted. Efforts were made to cover all available habitat types present at a site including riffles, pools, slack water, and areas of differing substrates. A four-hour timed search method was implemented at each site. Live mussels were held in the stream until processing.

Following the timed search, all live mussels and shells were identified to species and recorded (Tables 2 and 3). For each live individual, shell length (mm), gender, and an estimate of the number of growth rings were recorded. A species was considered extant at a site if it was represented by live or recently dead shell material (Szafoni 2001). Based upon condition of the best shell found, shell material was classified as recent dead (periostracum present, nacre pearly, and soft tissue may be present) or relict (periostracum eroded, nacre faded, shell chalky). Additional mainstem sites (sites 5-11, and 19) were added focusing solely on presence/absence of mussels to further investigate any impact from the 2009 fish kill on the mussel populations. At these sites, shell length, gender, and growth ring counts were not recorded due to time restraints. The nomenclature employed in this report follows Turgeon et al. (1998) except for recent gender updates to *Toxolasma* species (Williams et al. 2008, Appendix 1). Voucher specimens were retained and deposited in the Illinois Natural History Survey Mollusk Collection. All non-vouchered live mussels were returned to the stream reach where they were collected.

Other parameters recorded comprised of extant and total species richness, presence of rare or listed species, and individuals collected, expressed as catch-per-unit-effort (CPUE; Tables 2 and 3). A population was considered to indicate recent recruitment if individuals less than 30 mm in length or with three or fewer growth rings were observed. Finally, mussel resources were classified as Unique, Highly Valued, Moderate, Limited, or Restricted (Tables 2 and 3) based on the above parameters (Table 4) and following criteria outlined in Table 5 (Szafoni 2001).

Results

Species Richness

In our survey, 27 species were found to be extant (live + dead shell) within the basin (Tables 2 and 3). The number of live species collected in the Rock River mainstem ranged from 2 to 13, the number of extant collected ranged from 3 to 16, and total number of species (live + dead + relict) collected in the mainstem ranged from 4 to 20. The pimpleback (*Quadrula pustulosa)* was observed at all 22 mainstem sites sampled (Figure 5a). The plain pocketbook (*Lampsilis cardium*), fragile papershell (*Leptodea fragilis*), state-threatened black sandshell (*Ligumia recta*), Wabash pigtoe (*Fusconaia flava*), and pink papershell (*Potamilus ohiensis*) were other commonly occurring species across sites (ranging between 86% and 50%, Figure 5a).

The number of live and extant species collected in the minor tributaries ranged from 0 to 10, and the total number of species collected was 0 to 11. The plain pocketbook and white heelsplitter (*Lasmigona complanata*) occurred most often throughout the minor tributaries (5 of 14 sites, 36% each, Figure 5b). Other commonly occurring species included the fatmucket (*Lampsilis siliquoidea*; 29%), the Wabash pigtoe and ellipse (*Venustaconcha ellipsiformis*; both 21%).

The mainstem sites with the greatest species richness were site 17 and site 18, with 13 live species collected. In the minor tributaries, two sites on the Kyte River had the greatest species richness with 9 and 10 live species (sites 28 and 29, respectively).

Abundance and Recruitment

On the mainstem, a total of 1358 individuals were collected across 22 sites. Live mussels were observed at all sampling sites. The number of live specimens collected at a given site ranged from 2 to 284, with an average of 61 mussels per site (Table 2). Mussel abundance at individual mainstem sites ranged from low to moderately high and CPUE ranged from 1 to 68 individuals/collector-hour (Table 2). A total of 88 collector-hours were spent sampling in mainstem sites, with an average of 15 mussels collected per hour**.** The mainstem site with the greatest mussel abundance was site 17 yielding 284 individuals. The most common species observed across mainstem sites were the pimpleback (n=621), plain pocketbook (n=192), fragile papershell (n=140), threehorn wartyback (*Obliquaria reflexa*, n=129), and black sandshell (n=74), which, when combined, comprised 86% of total mainstem collections.

In the minor tributaries, a total of 331 individuals were collected across 8 of 14 sites (Table 3). Six sites yielded no mussels at all. The number of live specimens collected ranged from 1 to 203, with an average of 41 mussels per site. Mussel abundance at tributary sites ranged from none to moderately high and CPUE ranged from 0 to 51 individuals/collector-hour (Table 3). A total of 56 collector-hours were spent sampling in tributary sites, with an average of 10 mussels collected per hour at sites where mussels were present. The most common species observed were the plain pocketbook (n=146), white heelsplitter (n=41), elktoe (*Alasmidonta marginata*, n=39), pimpleback (n=35), and cylindrical papershell (*Anodontoides ferussacianus*, n=21), which, when combined, comprised 85% of total tributary collections.

Five species made up 80% of the total collection across the basin. These species include pimpleback (39%), plain pocketbook (20%), fragile papershell (8%), threehorn wartyback (8%), and black sandshell (5%).

Recruitment for each species was determined by the presence of individuals less than 30 mm or with three or fewer growth rings. Smaller (i.e., younger) mussels are harder to locate by hand grab methods and large sample sizes can be needed to accurately assess population

reproduction. However, a small sample size can provide evidence of recruitment if it includes individuals that are small or possess few growth rings. Alternatively, a sample consisting of very large (for the species) individuals with numerous growth rings suggests a senescent population. Recruitment levels are referred to in Table 4 as Reproduction Factor.

Additional mainstem sites (sites 5-11, and 19) focused solely on presence/absence of mussels to further investigate any impact from the 2009 fish kill on the mussel populations; therefore, eight sites were not included in calculating MCI parameters and scores since we did not record lengths and growth ring counts of specimens. These sites are excluded from Figure 5a. Recruitment at individual mainstem sites ranged from low to high across the basin. Seven sites (sites 1, 4, 13, 17, 18, 20, 22) exhibited moderate to high (30-50%) to very high recruitment (over 50%) while the remaining four sites (sites 12, 14, 15, 16) had none to minimal recruitment (0-30%; Figure 5a).

Among tributary sites, four sites exhibited high recruitment (sites 24, 26 - 28; 40-50%), one site had moderate recruitment (site 29; 30%), and the other nine sites had zero to minimal recruitment (0-10%). Six of these nine sites (sites 23, 30, 32, 33, 35, 36) had no live individuals found and were excluded from Figure 5b.

Mussel Community Index Score

Based on the data collected in the 2009 basin survey, nearly 80% of the sites on the Rock River mainstem are classified as Highly Valued or Unique mussel resources under the current MCI classification system (Table 2, Figure 5). Three sites (sites 17, 20, 21) ranked as Unique resources due to high species richness, listed species present, abundance and presence of disturbance intolerant species and high recruitment (Figure 5a). Eight sites (sites, 1, 3, 4, 12-14, 18, 22) ranked as Highly Valued resources and the remaining three sites (sites 2, 15, 16) were ranked as Limited resources.

In the minor tributaries, six sites (sites 23, 25, 32-33, 35-36) were Restricted resources, indicating no live mussels were present and minimal or no shell material was found. Three sites (sites 24, 31, 34) were Limited resources, one site (Franklin Creek, site 30) was a Moderate resource, and three sites (Stillman, Leaf, and Kyte Rivers, sites 26-28) were Highly Valued resources. One site on the Kyte River (site 29) ranked as a Unique resource (Table 2; Figure 5b) because of high species diversity, number of intolerant species found, and moderate reproductive success.

Noteworthy Finds

In the mainstem, the first live record since 1986 for rock pocketbook (*Arcidens confragosus*) and the second shell record for the washboard (*Megalonaias nervosa*) were recorded at site 18

(INHS Mollusk Collection Database). The state-threatened butterfly (*Ellipsaria lineolata*) was located by relict shell further upstream than in previous suveys. Historical species not found in the 2009 survey included flat floater (*Anodonta suborbiculata*), yellow sandshell (*Lampsilis teres*), and state-listed species such as elephantear (*Elliptio crassidens*), snuffbox (*Epioblasma triquetra*), ebonyshell (*Fusconaia ebena*) and spectaclecase (*Cumberlandia monodonta*), and federally-endangered Higgins eye (*Lampsilis higginsii*).

In the minor tributaries, the third live record for black sandshell was found (Site 29; Figure 3). The first shell (relict) record for purple wartyback (*Cyclonaias tuberculata*) was recorded at site 31 and a second shell record of flutedshell (*Lasmigona costata*) since the late 1800s was recorded from site 34. Pink papershell and creek heelsplitter (*Lasmigona compressa*) had been found live previously in the Kyte River, but it were not found at the two sites sampled in 2009 (e.g., site 29, Kyte River 2004; INHS Mollusk Collection Database).

Discussion

The first mussel surveys of the Rock River basin were conducted in the late 1800s and early 1900s. Baker (1926) compiled previous survey information regarding the Rock River basin and Miller (1970) updated Baker's work with a survey of the mainstem. Baker (1926) reported a total of 31 live species while Miller (1970) collected 21 live species. During our survey, we collected 22 live (23 extant) species (Table 2). Species we did not collect live in the mainstem that have been recorded live or extant within the last two decades include: spike (*Elliptio dilatata*), butterfly, purple wartyback, pistolgrip (*Tritogonia verrucosa*), wartyback, and monkeyface (*Quadrula metanevra*). Other shells collected were from species such as the flutedshell, ellipse, and yellow sandshell and appear to have undergone a major decline or were historically rare (e.g., ellipse and yellow sandshell) (INHS Mollusk Collection Database). The rock pocketbook appears to be rare throughout the mainstem, and only one live individual was found. This species was recorded previously at the mouth of the Rock River in 1986 (INHS Mollusk Collection Database). Several species not found in our survey, such as the flat floater and state-endangered ebonyshell, elephantear, and federally-endangered Higgins eye also appear to have been historically rare (INHS Mollusk Collection Database).

Species composition from historical records to our present survey changed slightly. In general, there appears to be a major loss of Amblemines, except species such as pimpleback and Wabash pigtoe, which have ictalurid and centrarchid host fish, respectively. There is an increased presence of Lampsiline species in the mainstem (Table 2). Several live species were only found from the mouth of the Rock River to site 17 and 18, just below the dams at Dixon and Sterling/Rock Falls (Table 2). Miller's (1970) study highlighted the loss of large mussel beds in the Rock River and a noticeable decline in mussel abundance, particularly downstream of Sterling/Rock Falls. His survey was conducted a year after clamming practices for the cultured

pearl industry ended in 1969 on the Rock River. During our survey, extensive mussel beds were not observed, with the exception of sites 14 (n=188, near Grand Detour) and 17 (n=284, south of Anna Page Park at Dixon). These two sites were dominated by two or three common species (Table 2). Other sampling procedures, such as brailing and diving, would be useful to fully assess the extent and intactness of mussel beds throughout the mainstem.

In the minor tributaries, two species not collected during this survey included creek heelsplitters and pink papershell. Creek heelsplitters are generally rare throughout their range and the lack of detection during this survey could mean they were simply not found. Recent records for pink papershell are from sites not sampled during our survey; these sites would need to be sampled to determine if the species still exists in this basin (or tributaries). The state-listed black sandshell was detected live further upstream than any previous records. This may suggest minor range expansion from the mainstem into smaller tributaries. Possible causes could include fish introductions or movements or non-detection in previous surveys due to the species' rarity in these minor tributaries. Black sandshell is a generalist and uses walleye, plus other common centrarchid and cyprinid hosts. This species appears to be doing well in the mainstem (n=74, Table 2). The IDNR actively manages the Rock River, stocking fish most years. Prior to 2009, walleye was the dominant fish stocked. In 2009, walleye, smallmouth bass, and channel catfish were stocked in the Rock River mainstem, and in 2010, walleye, channel catfish and bluegill were stocked. The 2009/2010 fish stockings were in response to the fish kill that occurred in summer 2009 where over 72,000 fish were killed (Bowman 2009). Our intensive survey efforts detected minimal adult mortality; however, fresh dead shells of pimpleback were frequently observed throughout the river where the fish kill occurred. Given the necessity of fish hosts for glochida transformation, a mussel cohort for 2009 or a large number of potential fish hosts may have been lost, but long-term effects on these mussel populations are unknown. Some of the walleye released in 2010 were inoculated with black sandshell glochidia (mussel larvae) before being released into the mainstem in the hopes of successful transformation and recruitment of this threatened species (IDNR, personal communication).

Mussel Community Index and Recruitment

In spite of the impact of dams and historical clamming practices (e.g., commercial harvest for button and pearl industries), 11 Rock River sites (1, 3, 4, 12-14, 17,18, 20-22) sampled in 2009 are considered Highly Valued or Unique resources according to the Mussel Community Index. Eight sites (5-11, 19) were not included in MCI calculations as previously mentioned. These 8 sites had 4 to 9 live species and 4 to 12 extant species present with numerous live individuals observed (Table 2). Several of these sites displayed fairly intact mussel fauna suggesting that these mussel communities are viable and self-maintaining at this time. Three mainstem sites (2, 15, 16) were considered Limited resources with minimal mussel representation. This may

have been due to lack of viable habitat (shifting sandbars) or failure to collect all species present, including juveniles, because of sampling conditions or methods (qualitative vs. quantitative). Sampling methods to target juvenile mussels would be necessary to better assess the reproductive status of these populations.

In the minor tributaries, four sites (26-29) were considered Highly Valued resources and one site a Unique resource. One site (30) was considered a Moderate resource and nine sites (23-25, 31-36) were classified as Limited or Restricted resources due to a lack of live or shell presence. Most of these streams have been assessed previously as fully supporting aquatic life (Sinclair 1996; IEPA 2010). For example, 87% of the Kyte River and its tributaries and 68% of the Elkhorn and Rock Creeks assessed reaches are classified as full support for aquatic life (Sinclair 1996; IEPA 2010). Interestingly, at Rock Creek we did not find any live mussels or shell, but this could have been due to stream conditions (high water level) and lack of suitable substrate for mussels (shifty sand, clay banks, high gradient).

Mussel community of the Rock River basin

Historically, 45 species were present in the Rock River and minor tributaries, but our survey collected a total of 23 extant species in the mainstem with four additional species in the minor tributaries (INHS Mollusk Collection Database; Tables 2 and 3). Large portions of the Rock River and its minor tributaries have been classified as a Highly Valued Aquatic Resource (Page et al. 1992; IDNR 2001). Even with this listing, species richness within the mainstem is declining. Plausible reasons for an initial decline may be due to historical clamming practices and installation of the seven dams, thereby impeding fish passage. Increased sedimentation from historical habitat degradation and intensive agricultural practices compounded with the release of municipal and industrial waste into the mainstem has likely been detrimental to mussel populations. As mentioned previously, it appears mussel fauna in the minor tributaries is remaining intact at sites with live mussels present. Continued monitoring of mussel species' gains and losses, in conjunction with other aquatic fauna, will be important for assessing and recognizing trends in the overall integrity within the Rock River basin.

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Table. 1. 2009 Rock River Intensive Basin Survey. Sites are listed from upstream to downstream, mainstem (1-22) and its minor tributaries (23-36). Types of samples include MU-mussel sampling, BE-boat electrofishing, ES-electric fish seine, SH-fish seine hauls, W-water chemistry, S-sediment, H-habitat, M-macroinvertebrate, FF-fish flesh contaminate.

Site Number	IEPA Code	Stream	Types of Samples	County	Location	Watershed Area (km^2)
1	P-05	Rock River	MU	Winnebago	2 mi SE of Rockton; Hononegah Forest Preserve	16344.93
2	P-27	Rock River	MU,BE,SH,W,S,M	Winnebago	Atwood Homestead Forest Preserve boatramp	16607.11
3	P-23	Rock River	MU,BE,W,S,M	Winnebago	Rockford; Blackhawk Park	16779.52
4	P-14	Rock River	MU,BE,W,S,M	Ogle	Byron; 1 1/2 mi downstream public boat ramp	20515.41
5	P-41	Rock River	MU	Ogle	1/4 mi S of Oregon; below dam	21063.55
6	P-43	Rock River	MU	Ogle	3/4 mi S of Oregon; below dam	21063.55
7	n/a	Rock River	MU	Ogle	2 mi S of Oregon; downstream of RR bridge	21063.55
8	n/a	Rock River	MU	Ogle	2 1/4 mi S of Oregon; downstream of RR bridge	21063.55
9	P-34	Rock River	MU	Ogle	Castle Rock overlook	21630.53
10	P-11	Rock River	MU,BE,W,S,M,FF	Ogle	Castle Rock State Park	21630.55
11	n/a	Rock River	MU	Ogle	downstream Castle Rock State Park	21630.53
12	n/a	Rock River	MU	Ogle	downstream Castle Rock State Park	21630.53
13	n/a	Rock River	MU	Ogle	2 mi N of Grand Detour	21630.53
14	P-20	Rock River	MU	Lee	0.5 mi NW of Grand Detour; downstream SR 2 bridge	21843.35
15	n/a	Rock River	MU	Lee	3 1/2 mi S of Grand Detour; 1 mi upstream Lowell Park	22134.07
16	P-95	Rock River	MU	Lee	1 mi NE Dixon; above dam	22134.07
17	P-10	Rock River	MU,BE,W,S,M	Lee	2 mi SW of Dixon; S of Anna Paige Park	22134.07
18	P-28	Rock River	MU,BE,W,S,H,	Whiteside	6 1/2 mi SW of Rock Falls; Lyndon roadside boat ramp	22447.66
19	P-12	Rock River	MU	Whiteside	1 mi upstream Prophetstown St. Park	23614.95
20	P-24	Rock River	MU,BE,W,S,M	Whiteside	2 mi downstream Prophetstown; head of Indian island	23298.30
21	P-46	Rock River	MU,BE,W,S,H,M,FF	Whiteside	Public launch S of Erie; Erie Co Rd bridge	24317.25
22	P-25	Rock River	MU	Rock Island	Rock Island; downstream Route 67 bridge	27833.04
23	PT-01	Kinnikinnick Creek	MU,ES,W,S,H,M	Boone	Kinnikinnick Creek Conservation Area	24.91
24	PSB-01	North Fork Kent Creek	MU,ES,W,S,H,M	Winnebago	Anna Page Conservation Area	38.33
25	PR-99	Keith Creek	MU,ES,W,S,H,M	Winnebago	Rockford; 10th Ave. Park	36.27
26	PP-01	Stillman Creek	MU,ES,W,S,H,M	Ogle	2 mi S of Stillman Valley; Holcomb Rd bridge	42.71
27	PN-03	Leaf River	MU,ES,W,S,H,M	Ogle	3 mi NW of Leaf River; White Eagle Camp	82.16
28	PL-18	Kyte River	MU,BE,W,S,H,M	Ogle	4.5 mi WNW of Rochelle; Flagg Rd bridge	306.90
29	n/a	Kyte River	MU	Ogle	5.5 mi SE of Oregon; Rocky Hollow Rd bridge	330.72
30	PK-01	Franklin Creek	MU,ES,W,S,H,M	Lee	3 mi NW Franklin Grove; Franklin Creek State Park	74.22
31	PJ-01	Pine Creek	MU,ES,W,S,H,M	Ogle	White Pines Forest State Park	117.38
32	PZR-03	Threemile Branch	MU,ES,W,S,H,M	Lee	4.5 mi E of Rock Falls; Nelson Rd bridge	94.71
33	PHE-01	Buffalo Creek	MU,ES,W,S,H,M	Whiteside	10 mi N of Sterling; James Rd bridge	69.59
34	PH-16	Elkhorn Creek	MU,BE,W,S,H,M,FF	Whiteside	8 mi N of Sterling; Pilgrim Rd bridge	374.25
35	PHB-01	Sugar Creek	MU,ES,W,S,H,M	Whiteside	4 mi N of Sterling; Fulfs Rd bridge	62.87
36	PE-06	Rock Creek	MU,BE,W,S,H,M	Whiteside	Morrison; Rt. 30 bridge	410.96

Table 2. Mussel data for mainstem sites sampled during 2009 surveys (Table 1). Numbers in columns are live individuals collected, "D" and "R" indicates that only dead or relict shells were collected. Shaded boxes indicate historic collections at the specific site location obtained from the INHS Mollusk Collection records. Extant species is live + dead shell and total species is live + dead + relict shell. Proportion of total is number of individuals of a species divided by total number of individuals at all sites. MCI scores and Resource Classification are based on values in Tables 3 and 4 (R=Restricted, L=Limited, M=Moderate, HV=Highly Valued, and U=Unique). NDA = no data available. Species in bold are federally or state-listed species or species in Greatest Need of Conservation by IL DNR.

	Site Number																						Proportion
Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	**of Total**
Subfamily Margartifera																							
Cumberlandia monodonta																							0.0%
Subfamily Anodontinae																							
Alasmidonta marginata			D	R		D					1		D	D			R						0.1%
Arcidens confragosus																		1					0.1%
Lasmigona complanata	R	R							R			R		1	1	D	1	4		1			0.6%
Lasmigona costata		R	R																				0.0%
Pyganodon grandis	2		D		2							D		1			2	D	D				0.5%
Strophitus undulatus	R					R						1		4				1	D	D	R		0.4%
Utterbackia imbecillis				1								D					2		D				0.2%
Subfamily Ambleminae																							
Amblema plicata	R		R	R	R							R	R		R	R	R	R	R	R	R	6	0.4%
Cyclonaias tuberculata	R	R	R	R		R			R		R	R	R		R		R		R	R		R	0.0%
Elliptio crassidens																							0.0%
Elliptio dilatata	R	R	R	R		R					R	R	R	R	R		R	R	R	R			0.0%
Fusconaia flava	2		1	3	1	R	12	4	1		R	1	2	1	R		2	2		R		D	2.4%
Megalonaias nervosa																		D					0.0%
Plethobasus cyphyus	R				R				R				R		R		R	R					0.0%
Pleurobema rubrum			R								R	R			R								0.0%
Pleurobema sintoxia	D					D			1				1										0.1%
Quadrula metanevra																		R	R	R	R	R	0.0%
Quadrula nodulata																						R	0.0%
Quadrula pustulosa	6	1	4	23	12	40	33	16	26	55	10	49	68	65	2	24	144	9	13	1	14	6	45.7%
Quadrula quadrula																		1	3	3		D	0.5%
Tritogonia verrucosa	R	R			R				R			R							R	R	R	R	0.0%
Subfamily Lampsilinae																							
Actinonaias ligamentina	R	R	R	R	1	20	2	1			R	3	1		R		6	1	R		R	D	2.6%
Ellipsaria lineolata												R	R									R	0.0%
Epioblasma triquetra																							0.0%
Lampsilis cardium	4	R	1	15	5	6	20	6	19	2	1	11	7	57	D		8	5	13	8	2	2	14.1%
Lampsilis siliquoidea	R	R	R											R	R						R		0.0%
Leptodea fragilis	10	1	1	D	7	4	10	10	7	3	1	4	4	53	D		5	2	1	8	R	9	10.3%
Ligumia recta	1	D	D	1		6	10	6	1	1	1	3	7	3			2	25	R	7	D	D	5.4%
Obliquaria reflexa																	108	7	6	3	3	2	9.5%
Obovaria olivaria	R																	4	7	1	5	5	1.6%
Potamilus alatus																		25	2	1	2	D	2.2%
Potamilus ohiensis			2	1		D	1	4	2			4	4	3	D	5	2		1				2.1%
Taxolasma parvum				1													1						0.1%
Truncilla donaciformis	1	D				1		1						R	R		1					D	0.3%
Truncilla truncata																	R	D	2	3	2	R	0.5%
Venustaconcha ellipsiformis						R															R		0.0%
																							Totals
Individuals collected	24	2	9	44	26	77	88	48	57	61	13	75	94	182	2	29	279	81	48	35	28	30	1332
Live Species	6	2	5	6	5	6	7	8	7	4	4	7	8	6	1	2	10	10	9	9	6	6	16
Extant Species	7	4	8	7	5	8	7	8	7	4	4	7	8	6	4	2	10	12	9	9	7	12	17
Total Species	17	10	12	11	8	12	7	8	10	4	9	13	13	9	13	3	15	16	16	15	14	18	27
Historical Species	10	16	16	19	8	8	1	8	16	16	16	6	15	17	7	5	19	13	24	24	1	12	42
Catch per unit effort (CPUE)	6.5	1.0	2.3	11.3	7.0	19.0	22.0	11.0	14.3	15.3	3.3	18.8	47.0	46.2	0.7	6.4	67.6	21.8	11.4	8.6	6.7	7.2	
Mussel Community Index (MCI)	12	7	13	14	NDA	NDA	NDA	NDA	NDA	NDA	NDA	12	15	13	5	6	18	14	NDA	16	17	14	
Resource Classification	HV	L	HV	HV	NDA	NDA	NDA	NDA	NDA	NDA	NDA	HV	HV	HV	L	L	U	HV	NDA	U	U	HV	

Table 3. Mussel data for minor tributary sites sampled during 2009 surveys (Table 1). Numbers in columns are live individuals collected, "D" and "R" indicates that only dead or relict shells were collected. Shaded boxes indicate historic collections at the specific site location obtained from the INHS Mollusk Collection records. Extant species is live + dead shell and total species is live + dead + relict shell. Proportion of total is number of individuals of a species divided by total number of individuals at all sites. MCI scores and Resource Classification are based on values in Tables 3 and 4 (R=Restricted, L=Limited, M=Moderate, HV=Highly Valued, and U=Unique). Species in bold are federally or state-listed species or species in Greatest Need of Conservation by IL DNR. *includes *Tritogonia verrucosa* and *Potamilus ohiensis* which are not represented in the table.

	Site Number														Proportion
Species	23	24	25	26	27	28	29	30	31	32	33	34	35	36	**of Total**
Subfamily Anodontinae															
Alasmidonta marginata						38	1		R						11.8%
Alasmidonta viridis	**D**	**1**		**R**								**R**			0.3%
Anodontoides ferussacianus	D	D		19	D		R	2	D	R	D				6.3%
Lasmigona complanata				3		27	7		3			1			12.4%
Lasmigona compressa															0.0%
Lasmigona costata												**R**			0.0%
Pyganodon grandis						11	1		D			D			3.6%
Strophitus undulatus						2	2								1.2%
Subfamily Ambleminae															
Amblema plicata			R			D									0.0%
Cyclonaias tuberculata									**R**						0.0%
Elliptio dilatata								R							0.0%
Fusconaia flava						9	1					2			3.6%
Quadrula pustulosa						34	1								10.6%
Subfamily Lampsilinae															
Actinonaias ligamentina									1						0.3%
Lampsilis cardium			R		6	79	55		4			2			44.1%
Lampsilis siliquoidea				1		1	1	R	2						1.5%
Leptodea fragilis						2						D			0.6%
Ligumia recta							**2**								0.6%
Potamilus alatus												1			0.3%
Toxolasma parvum		D		1											0.3%
Venustaconcha ellipsiformis				**1**	**6**		**1**		**R**						2.4%
															Totals
Individuals collected	0	0	0	3	12	125	61	0	7	0	0	5	0	0	213
Live Species	0	0	0	3	2	5	6	0	0	0	0	3	0	0	10
Extant Species	0	1	0	3	2	6	6	0	0	0	0	4	0	0	11
Total Species	0	1	2	3	2	6	6	2	0	0	0	4	0	0	13
Historical Species	NDA	3	NDA	NDA	NDA	12	11	NDA	6	NDA	NDA	6	NDA	NDA	23*
Catch per unit effort (CPUE)	0.0	0.0	0.0	0.8	3.0	52.1	17.9	0.5	2.5	0.0	0.0	1.3	0.0	0.0	
Mussel Community Index (MCI)	0	6	0	12	12	15	16	8	7	0	0	7	0	0	
Resource Classification	R	L	R	HV	HV	HV	U	M	L	R	R	L	R	R	

Table 4. Mussel Community Index parameters and scores.

Extant species in sample	Species Richness		Catch per Unit Effort (CPUE)	Abundance (AB) Factor
0	1		0	0
1-3	2		1-10	2
4-6	3		>10-30	3
7-9	4		>30-60	4
10+	5		>60	5
% live species with recent recruitment	Reproduction Factor		# of Intolerant species	Intolerant species Factor
0	1		0	1
1-30	3		1	3
>30-50	4		2+	5
>50	5			

Table 5. Freshwater mussel resource categories based on species richness, abundance, and population structure. MCI = Mussel Community Index Score

Unique Resource MCI ≥ 16	Very high species richness (10 + species) &/or abundance (CPUE > 80); intolerant species typically present; recruitment noted for most species
Highly Valued Resource MCI = 12- 15	High species richness (7-9 species) &/or abundance (CPUE 51-80); intolerant species likely present; recruitment noted for several species
Moderate Resource MCI = 8 - 11	Moderate species richness (4-6 species) &/or abundance (CPUE 11-50) typical for stream of given location and order; intolerant species likely not present; recruitment noted for a few species
Limited Resource MCI = 5 - 7	Low species richness (1-3 species) &/or abundance (CPUE 1-10); lack of intolerant species; no evidence of recent recruitment (all individuals old or large for the species)
Restricted Resource MCI = 0 - 4	No live mussels present; only weathered dead, sub-fossil, or no shell material found

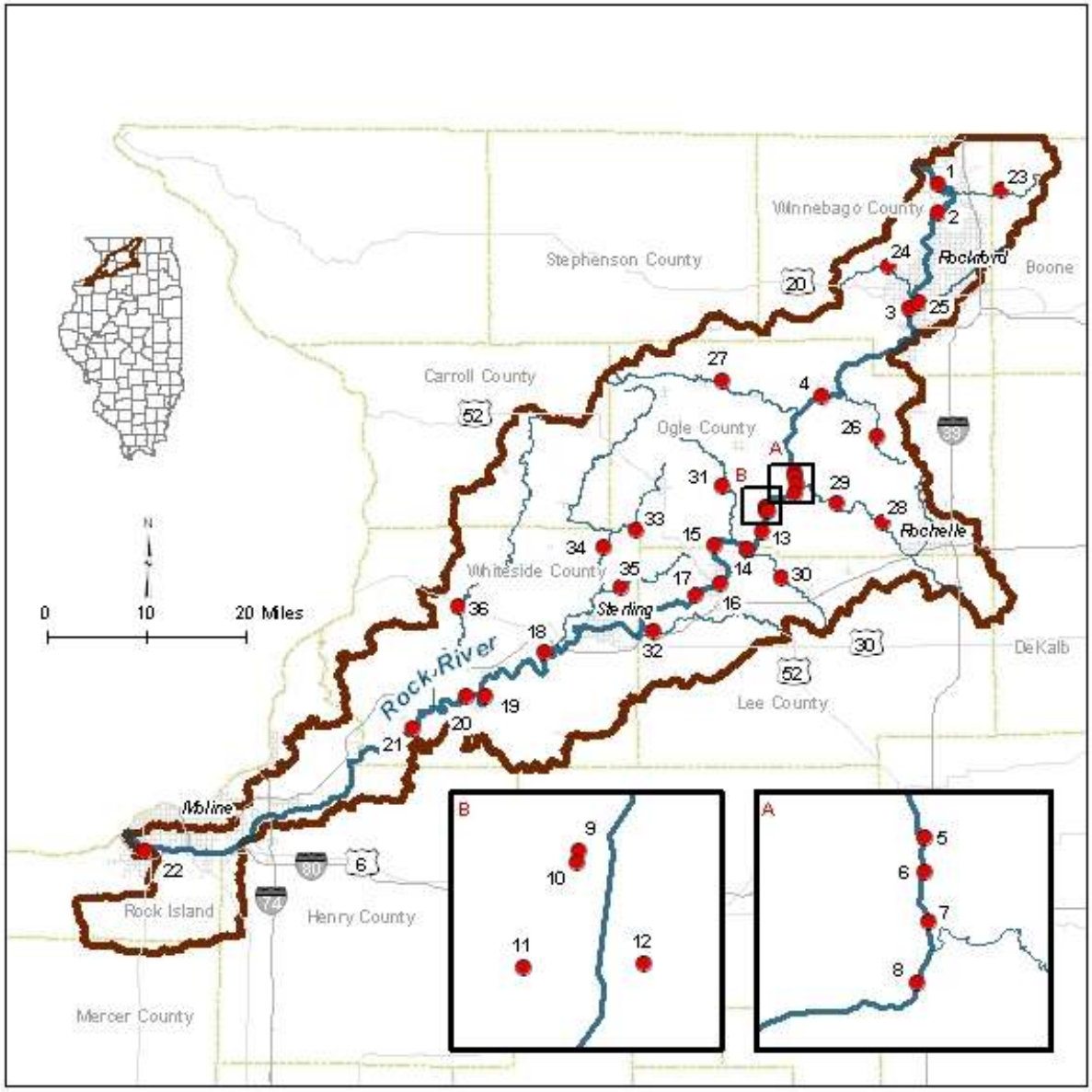
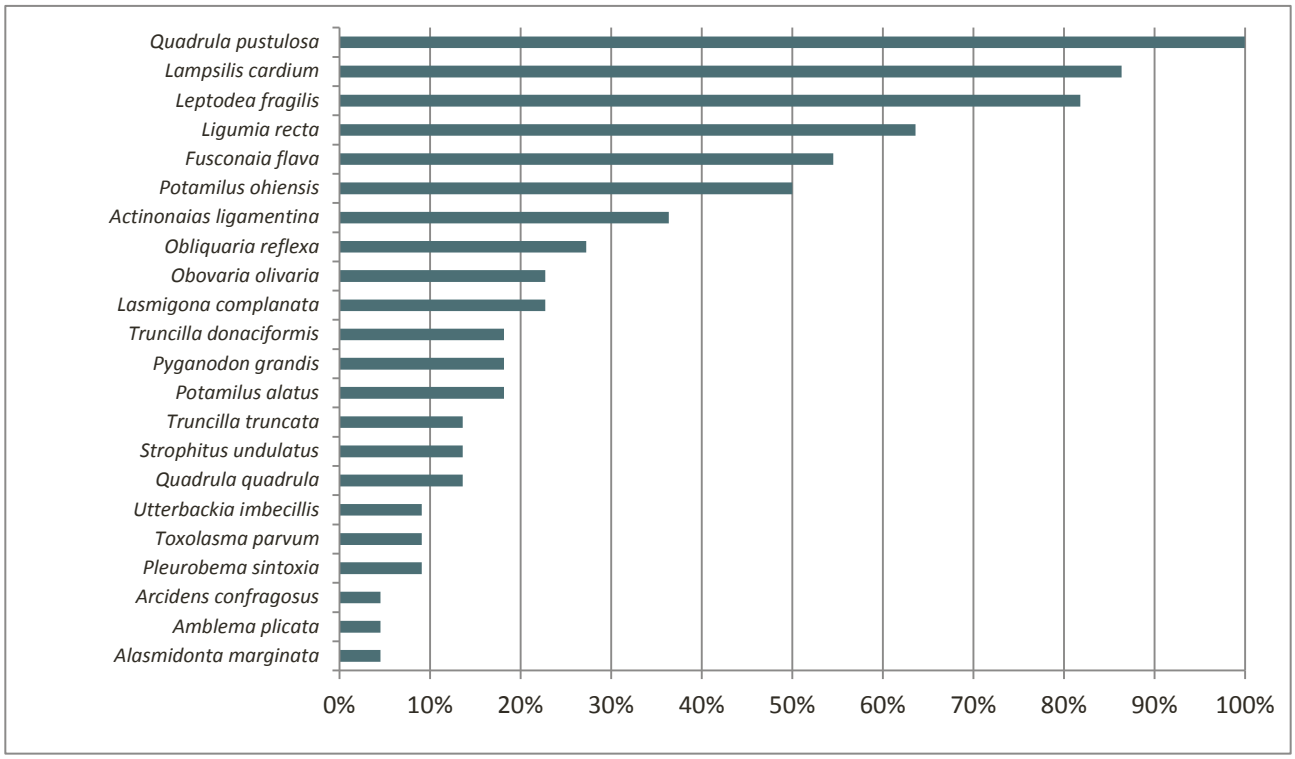


Figure 1. Sites sampled in the Rock River basin in 2009. Site codes referenced in Table 1. Sites 9-12 in square B were sampled at islands or along the bank thus not residing on the river.

Figure 2. Rock River with substrate predominately gravel/sand and cobble (site 14, on right) with exposed islands (site 18, on left).

Figure 3. Kyte River (site 29) at Rocky Hollow Bridge road—substrate gravel/sand mix (on right). Male and female black sandshells at site 29 (on left).

a) Rock River



b) Rock River minor tributaries

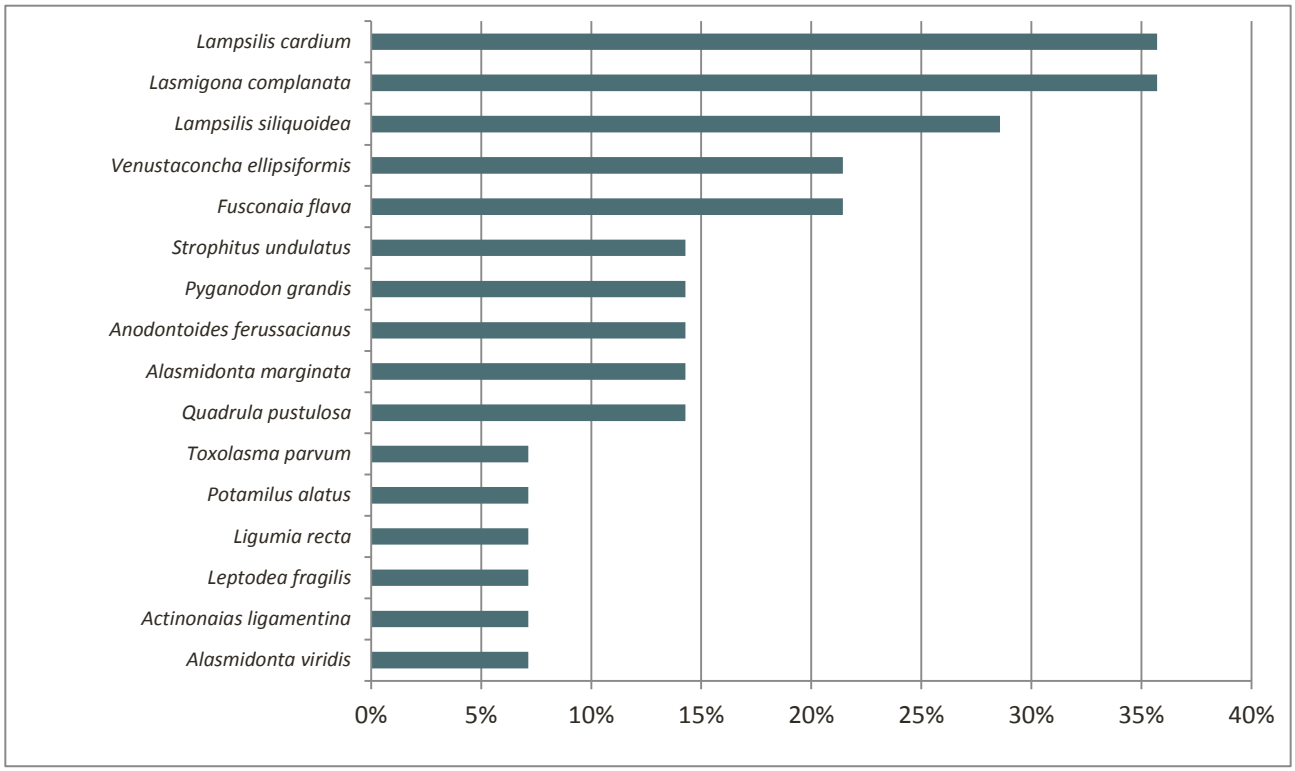
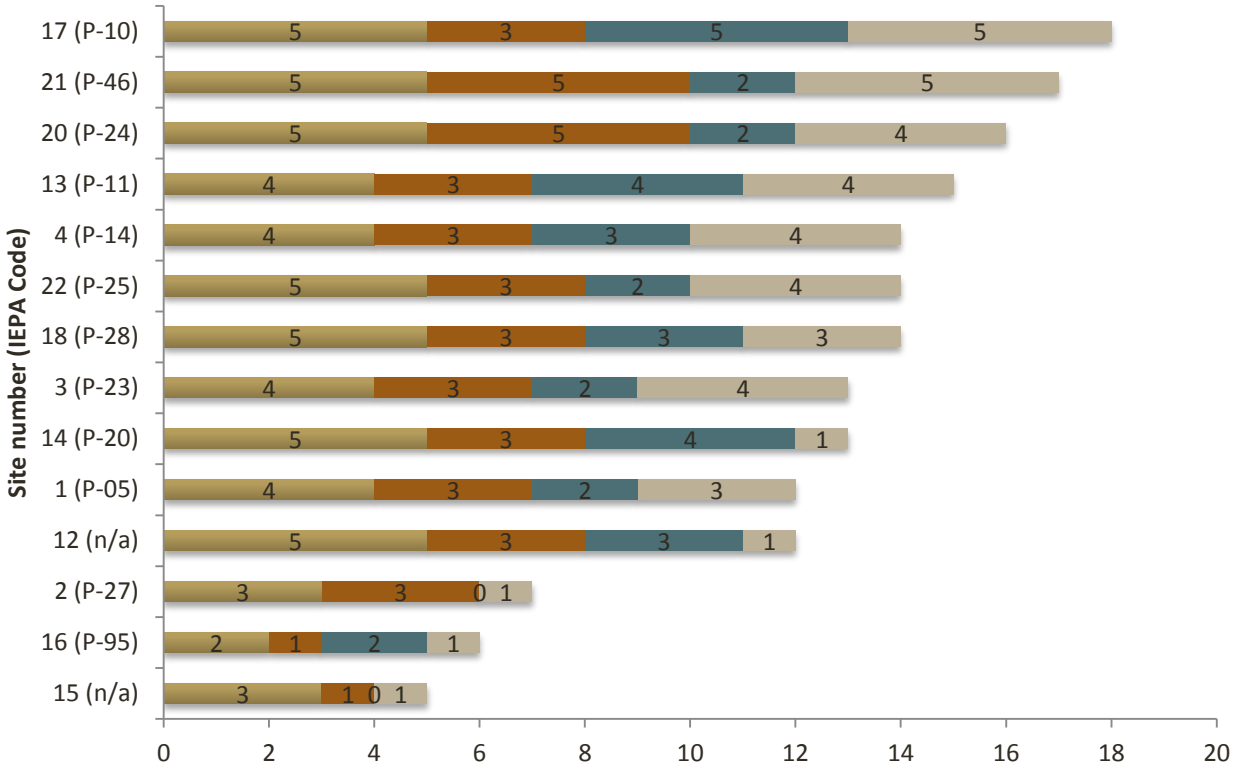


Figure 4. Rock River basin species occurrence by percentage: number of sites with live species collected compared to the number of total sites sampled. a. Rock River mainstem, 22 sites, b. Rock River tributaries, 14 sites.

a) Rock River



b) Rock River minor tributaries

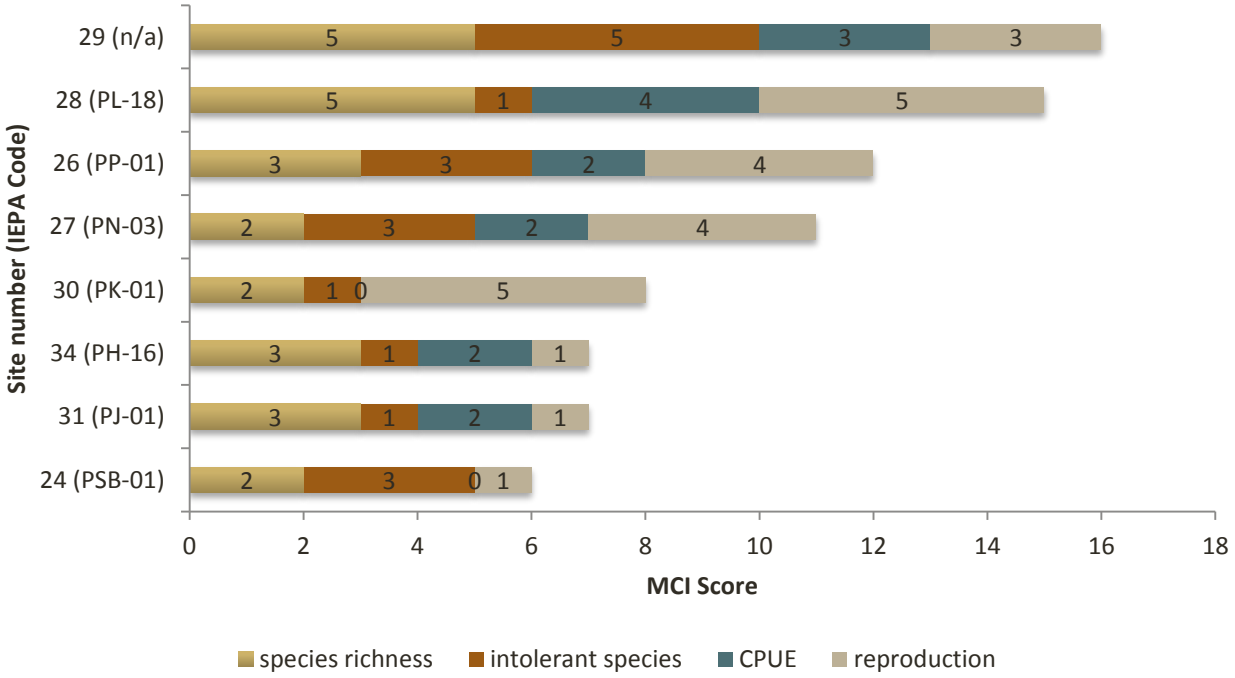


Figure 5. Comparison of Mussel Community Index (MCI) and its parameter scores for the Rock River basin based on factor values from Table 4.

Appendix 1. Scientific and common names of species. Status refers to conservation status in Illinois at time of printing (2012); ST-state threatened, SE-state endangered, FE-federally endangered.

Scientific Name	Common Name	Status
Subfamily Margaritifera		
Cumberlandia monodonta	spectaclecase	FE
Subfamily Ambleminae		
Amblema plicata	threeridge	
Cyclonaias tuberculata	purple wartyback	ST
Elliptio crassidens	elephantear	ST
Elliptio dilatata	spike	ST
Fusconaia ebena	ebonyshell	ST
Fusconaia flava	Wabash pigtoe	
Megalonaias nervosa	washboard	
Plethobasus cyphyus	sheepnose	FE
Pleurobema rubrum	pyramid pigtoe	ST
Pleurobema sintoxia	rough pigtoe	
Quadrula metanevra	monkeyface	
Quadrula nobilis	Gulf mapleleaf	
Quadrula nodulata	wartyback	
Quadrula pustulosa	pimpleback	
Quadrula quadrula	mapleleaf	
Tritogonia verrucosa	pistolgrip	
Subfamily Anodontinae		
Alasmidonta marginata	elktoe	
Alasmidonta viridis	slippershell	ST
Anodonta suborbiculata	flat floater	
Anodontoides ferussacianus	cylindrical papershell	
Arcidens confragosus	rock pocketbook	
Lasmigona complanata	white heelsplitter	
Lasmigona compressa	creek heelsplitter	
Lasmigona costata	flutedshell	
Pyganodon grandis	giant floater	
Strophitus undulatus	creeper	
Utterbackia imbecillis	paper pondshell	
Subfamily Lampsilinae		
Actinonaias ligamentina	mucket	
Ellipsaria lineolata	butterfly	ST
Epioblasma triquetra	snuffbox	FE
Lampsilis cardium	plain pocketbook	
Lampsilis higginsii	Higgins eye	FE
Lampsilis siliquoidea	fatmucket	
Lampsilis teres	yellow sandshell	
Leptodea fragilis	fragile papershell	
Ligumia recta	black sandshell	ST
Obliquaria reflexa	threehorn wartyback	
Obovaria olivaria	hickorynut	
Potamilus alatus	pink heelsplitter	
Potamilus ohiensis	pink papershell	
Toxolasma parvum	lilliput	
Truncilla donaciformis	fawnsfoot	
Truncilla truncata	deertoe	
Venustaconcha ellipsiformis	ellipse	